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I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

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Signed

Dated 2 September 2004

Patents Form 1/77

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P01/7700 0.00-0312550.7

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference NEL/PF/01

2. Patent application number *(The Patent Office will fill in this part)* 0312550.7

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

NEL TECHNOLOGIES LIMITED
WESTWAY INDUSTRIAL PARK,
THROCKLEY,
NEWCASTLE UPON TYNE, NE15 9HW

Patents ADP number *(if you know it)* 7946076002

If the applicant is a corporate body, give the country/state of its incorporation UNITED KINGDOM

4. Title of the invention FUNCTIONAL INSOLE HEATER FOR FOOTWEAR

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

MEWBURN ELLIS
YORK HOUSE
23 KINGSWAY
LONDON
WC2B 6HP

Patents ADP number *(if you know it)*

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

FS1/77 '2-6-04

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	3
Claim(s)	0
Abstract	0
Drawing(s)	1 + 1 RM

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature P. Ferguson Date 31/5/03

12. Name and daytime telephone number of person to contact in the United Kingdom DR. PATRICK FERGUSON 0191 264 0990

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

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Functional Insole Heater for Footwear

This invention relates to a breathable, porous, flexible insole heater and a thermally activated chemical delivery system for footwear.

Background

The design and utilisation of heater systems for footwear, particularly for ski-boot applications are described in the prior art for example, US5,041,717 and US4,798,933. The prior art teaches the use of a rigid electrical heating element embedded or otherwise fixed into a removable shoe insole unit, which can be cut to size (as required). An electrical connection to a battery is also provided, designed to be carried by the user.

Existing heater elements are limited by: their comparatively high cost; their thickness and rigidity; their lack of breathability to accommodate the microclimate conditions of footwear; the restricted area over which heating is applied and their limited design potential (in terms of aesthetics and capacity to be personalised). A further limitation of existing insole heaters is the cumbersome design of the electrical connection, which can sometimes be felt by the wearer as it passes beneath the main body of the insole when in use. This may in part explain the comparatively high thickness of existing heater insoles.

The present invention is intended to remove these limitations and advance the current state of the art in insole heater design for footwear by teaching the design of a breathable, cost-effective (disposable), thin, flexible fabric heater element, which is fully integrated with the insole unit and is capable of being washed and reused as required.

Invention

The invention comprises a flexible, porous metallised fabric heater element which is integrated within the construction of an insole for use in a wide variety of footwear applications (e.g. sports footwear, work and protection footwear, outdoor and leisure footwear). The wide variety of uses is made possible by the novel design of the new insole heater, which is thin, conformable and can incorporate heater elements of different sizes and specifications. In contrast to existing articles, the insole can also be made washable (without removing the heater element) and may be reused. Alternatively, the unit may be disposed of because of its low cost. The heater may also be printed to personalise its appearance by techniques such as thermostatic printing®, dye sublimation or ink jet printing.

Typically, the heater is composed of a thin, porous, etched metallised fabric element with a track pattern which can be configured during manufacture to regulate heating performance to provide uniform or differential heating to the foot. The differential heating is achieved using a constant electrical energy input and this is advantageous where heat needs to be delivered preferentially to particular parts of the foot (e.g. the toe

area) without constant adjustment of the input energy or use of multiple individual heaters. Temperature control of the heater is achieved by limiting the resistance of the element or by incorporating a thermal protection device in the element e.g. a surface mount thermistor chip. Details of the construction, manufacture and heating performance of a flexible, porous etched metallised fabric heater are described in UK patent application no. 0228999.9.

The heater element termination pads are at the end of the etched track and allow connection of the heater element to a battery/control system, which may be stored in the shoe itself (e.g. in the heel cavity) or elsewhere. It is an object of this invention to provide an electrical interconnect which does not run beneath the insole itself as this may cause discomfort to the wearer. Rather, it is preferred that the electrical interconnect between the heater element termination pads and the battery are provided at the rear of the insole, at the back of the foot and heel, so as to minimise the length of the electrical interconnect. Examples of interconnect solutions include, but are not limited to, suitable flexible substrate connection devices which utilise the flex-tail created from the etched metallised fabric. However, it will be understood that other termination positions and interconnection techniques are possible depending on the particular design of the insole and other performance requirements.

The porous fabric heater element may be incorporated in to an insole using conventional methods of insole manufacture. Typically, the breathable fabric heater element is laminated between the insole face fabric (which may usually be composed of nonwoven, knitted or woven fabrics) and for example, a foam backing. Other fabrics may be used in the composition of the insole depending on the design and the heater element may be placed between any one of these layers as required. The heater element may also be integrated within other insole constructions, including injection-moulded, compression-moulded, pre-moulded or shaped structures composed of for example, foams, thermoformed or metal substrates. Lamination may be achieved using commonly known manufacturing methods for example, thermal lamination may be carried out using meltblown thermoplastic webs, grids, nets, powders or polymeric coatings followed by compression to affect thermal adhesion of the different insole layers. Alternatively, other adhesives known in the art of shoe component manufacture can be used. The resulting insole heater is thin and flexible. Typically the insole thickness containing the heater element is in the range 0.1mm to 1.0mm thick but can be thicker if required using the appropriate insole materials.

Because the heater element is thin and flexible rather than rigid, it may be incorporated in to the insole so that it runs the full length of the insole rather than being positioned at one end only or at both the extremities. The heater is therefore required to repeatedly bend and deform in use, which is permitted due to the inherent design of the heater and insole. The presence of the element along the length of the insole also allows differential heating of the shoe to be achieved by changing the heater element track resistance characteristics along the insole. Therefore, for a

constant electrical input, the heating capacity along the insole can be varied.

A further object of this invention is to incorporate functional chemicals in to the insole and shoe, which can be initiated by the heater element. Such chemicals include antimicrobials (to suppress or kill microbiological activity), insect repellants (to repel mosquito's etc.) and perfumes. In a preferred approach such chemicals are microencapsulated in microcapsules, which melt at a particular initiation temperature or others, which allow diffusion of the active chemicals through their walls to effect a slow release mechanism within the insole. By appropriate temperature control, the heater element in the insole is then used to initiate the delivery of such active chemicals. It will be understood that by the encapsulation of various active chemicals and the use of microcapsules having different thermal characteristics, the timing of the delivery of each chemical can be controlled as required. Normally, the microencapsulated components will not form part of the heater element itself rather they will be contained within other layers of the insole e.g. the face fabric layer. The release of the chemicals is however achieved using the heater, which is preferably adjacent to the layer containing the microencapsulated components. The breathability of the fabric heater assists the circulation of the released functional chemicals.

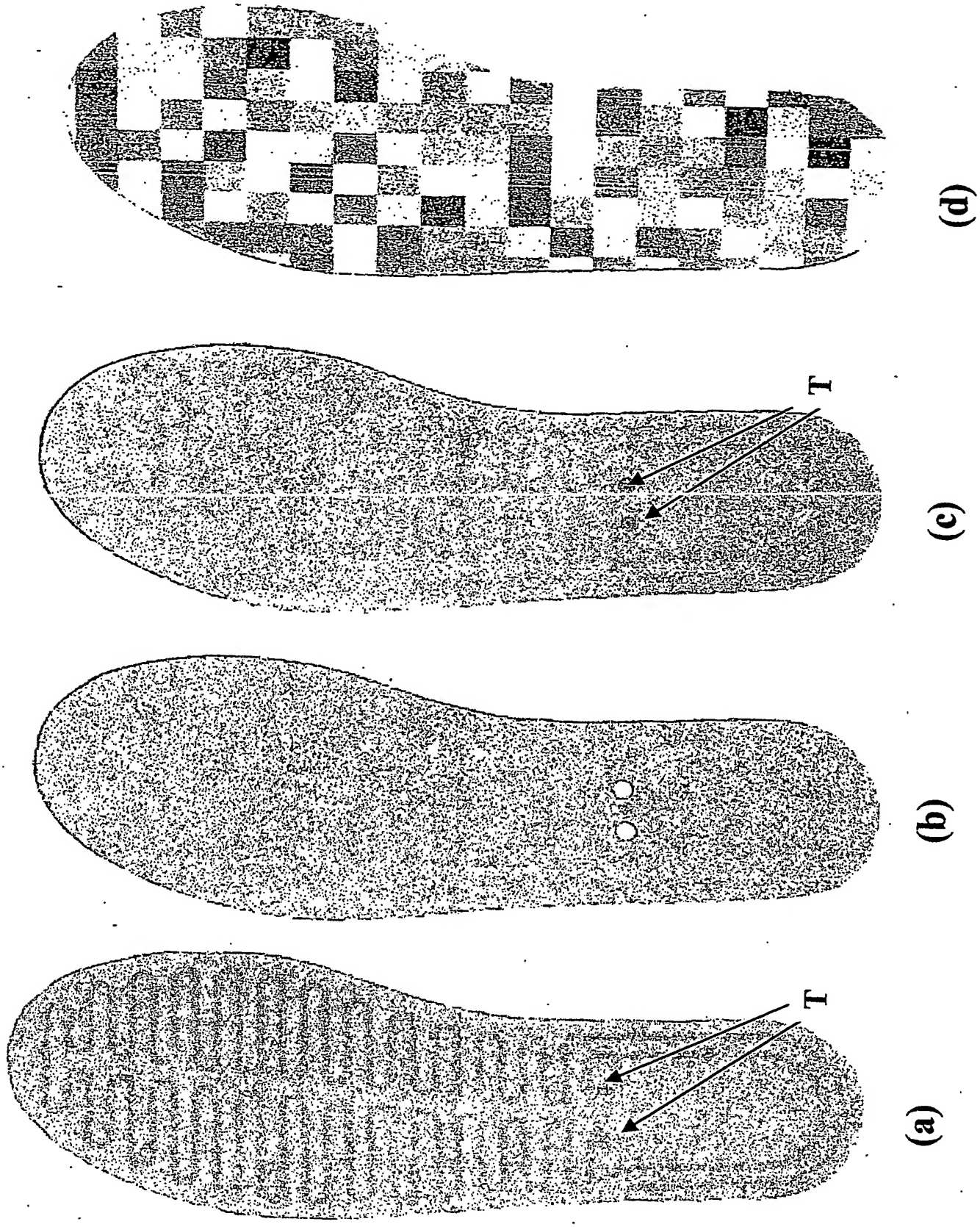
If the face fabric used in the construction of the insole is composed of a compatible polymer (e.g. polyamide, polyester or blends thereof), the heated insole unit may be thermostatic printed® or dye sublimation printed in order to improve its aesthetic design and appearance for the purpose of personalisation. Ink jet printing can also be used for the same purpose. The high resolution digital imaging printing processes do not interfere with the performance of the heater unit.

The insole may be cut to size to fit a wide variety of shoe sizes and internal profiles. The insole containing the heater element may also be removed from the shoe and washed (by hand or domestic washing machine) using conventional domestic detergents and rinsing methods and then reused if required.

An example of the invention is shown in figure 1. This shows a porous etched metallised fabric heater element profiled in the shape of an insole (figure 1a) with heater element termination pads (marked T). Figure 1b shows a suitable insole material which is bonded to both sides of the heater using a meltblown thermoplastic web resulting in a breathable insole heater (figure 1c). If required the insole material can incorporate a functional chemical delivery system. In addition the insole heater can be decorated with digital images as shown in figure 1d.

Clearly other embodiments and modifications of the invention will be obvious to those skilled in the art.

Figure 1



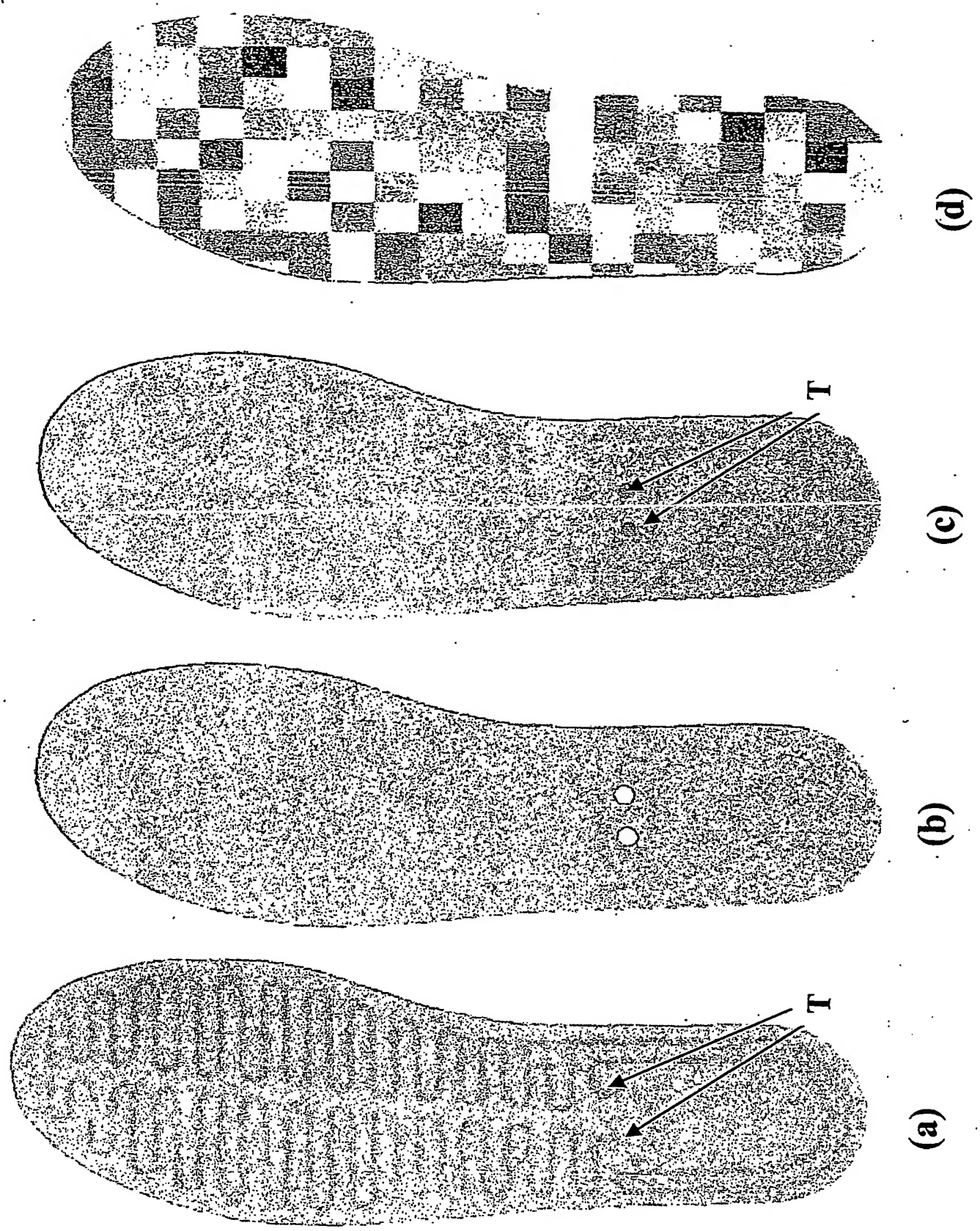


Figure 1